

CONTRIBUTIONS TO A KNOWLEDGE OF AUSTRALIAN ENTOZOA.

No. iii.—ON SOME SPECIES OF *Holostomidae* FROM AUSTRALIAN BIRDS.

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(Plates v.-vii.)

In the present paper, five species of *Holostomidae*, all parasites of Australian birds, are described as new. Two of them are referred to the genus *Hemistomum*, and three to the genus *Holostomum*. They were all collected by Dr. J. P. Hill, Demonstrator of Biology at the University of Sydney, and formed part of a collection of Trematodes and Cestodes given by him to me for investigation. In addition to the collection of worms, I am indebted to Dr. Hill for some valuable preparations of some of the specimens and notes as to their location in their hosts, &c.

Dr. Brandes' 'Monograph on the *Holostomidae*,' published in the *Zoologischer Jahrbücher*, Band v., has been of especial use to me in the preparation of this paper. The lengths given are measured along ventral body wall.

HEMISTOMUM TRIANGULARE, sp.n.

(Plate v., figs. 1-6.)

Length 2.3 mm.; the anterior region shorter than the posterior, about one-third of the total length. The flattened anterior body-region is triangular in shape, the mouth opening situated at the apex of the triangle; the lateral edges strongly curved round (Pl. v., fig. 5).

The clinging plug is situated near the junction with the posterior body-region, and its base of attachment is short, not

extending as far forwards as the position of the ventral sucker. It is roughly cubical in shape and is partly overhung by a lip or narrow hood formed by the flexed lateral flaps, which are fused together for a short distance at their posterior ends. It is split in the middle (Pl. v., fig. 2).

Oral sucker well formed, orbicular, larger than the pharynx, about equal in size to the ventral sucker. Oral sucker 0.06 mm. in diameter, pharynx 0.05 mm., ventral sucker 0.062 mm.

On either side of the oral sucker is the conspicuous opening of a group of unicellular glands. The ventral sucker is surrounded by a group of unicellular glands, each cell opening on the surface by a separate duct (Pl. v., fig. 4).

The alimentary canal divides into two immediately on leaving the pharynx, and the two well-developed arms are continued to the posterior end of the body.

The ovary is large, rounded and situated far forwards in the posterior body-region, near its junction with the anterior body-region. The testes are large, situated one behind the other, and behind the ovary. The uterus occupies a considerable part of the space in the posterior body-region; eggs large.

The vitelline glands are very numerous, extending from one end of the body to the other and into the clinging plug.

Found in the duodenum and small intestine of the Laughing Jackass, *Dacelo gigas*, Bodd. Collected at Jervis Bay, N.S.W.

#### HEMISTOMUM INTERMEDIUM, sp.n.

(Plate v., figs. 7-10.)

Length 3.6 mm.; length of anterior body-region 0.67 mm., length of posterior region 2.93 mm.

The anterior body-region is well marked off from the posterior and is strongly bent back on the posterior in a dorsal direction, giving the body a U-shaped form (Pl. v., figs. 6 and 7).

The foldings of the lateral body-edges ventralwards very marked; these folds are fused for some distance in their posterior part, so that the cup-shaped anterior body-part of the genus *Holostomum* is approached. In its clinging apparatus, too, this

species approaches the characters of that genus. Instead of being the simple, almost solid plug characteristic of *Hemistomum*, the clinging plug in this species consists of two parallel plates folded in a scroll-like manner towards one another (Pl. v., fig. 7).

The oral sucker is of moderate size (0.17 mm.) and the pharynx smaller; the ventral sucker (0.25 mm.) is very large and stalked, being raised up from the body-surface on a thick projection or stalk, about equal in length to the diameter of the sucker. On each side of the oral sucker is a group of very large unicellular glands, which open into a crescentic depression from the ventral body-surface.

The bursa copulatrix, which, together with the genital papilla, is fairly well developed, is turned to open dorsally. The ovary is situated far forwards in the cylindrical body-region, near its junction with the anterior body-region. Behind it are placed, one behind the other, two large testes. The uterus in its hinder part has its walls raised up into a number of transverse folds or ridges.

The vitelline glands, which are very numerous, occur along the whole length of the ventral aspect of the posterior body-part.

Found in the duodenum of the Black Swan, *Cygnus atratus*, Lath. Collected at Duckmaloi River, N.S.W.

#### HOLOSTOMUM HILLII, sp.n.

(Plate vi., figs. 1-8.)

Length 6.9-8.2 mm. Anterior body-region well marked off from the posterior region, one-seventh of the entire length.

The clinging apparatus or plug, which lies in the cavity of the cup-like anterior body-part, consists of two parts: a cushion-like mass, with a long base of attachment to the ventral body-wall, situated on the dorsal side of the cup and forming the dorsal mass of plug, and a ventral part consisting of a lamellous sheet, which may be described as H-shaped. It arises posteriorly from the ventral wall of the cup as two lateral flaps which, at about the middle of their length, become fused together for a short space

(Pl. vi., figs. 1-5). The cushion-like part of the plug is grooved in the mesial line by the deep longitudinal incision characteristic of this part in many species of the genus, which almost divides it into two, and does completely divide it in its anterior aspect, and each of these divisions, projecting for some distance beyond the rim of the cup, ends in a knobby club-shaped head.

The oral and ventral suckers are about the same size (0.13 mm.); the pharynx is a little smaller (0.08 mm.). A short oesophagus follows on the pharynx; the two limbs of the intestine, lined by a single layer of large deeply-staining cells, are continued to the extreme posterior end of the body (Pl. vi., fig 8). The excretory system of vessels is well developed.

The ovary is a rounded, solid body, situated dorsally about the middle of the posterior body-region. The uterus runs forward almost to the junction of the anterior and posterior body-regions, and, in those specimens in which it is filled with eggs, occupies the greater part of the body-space. The testes are oval, solid organs, lying one behind the other just behind the ovary.

The vitelline glands do not extend into the anterior body-region, but extend throughout the whole length of the posterior body-region, surrounding the other organs.

The vesicula seminalis is large and coiled, and leads into a duct which opens into the female duct just before that duct opens on the extremity of the genital papilla.

The bursa copulatrix is very large, larger than the anterior body-region. A strong sphincter muscle surrounds the orifice of the bursa; and less strong sphincter muscles are present in the base of the bursa near its junction with the rest of the body, and also at the base of the genital papilla. A well marked circular muscle is present throughout the length of the genital papilla, and strong longitudinal fibres are seen in both the papilla and walls of the bursa.

Found in the duodenum of the Australian Gull, *Larus novae-hollandiae*, Stephens. There is just the bare possibility of doubt about the specific identity of this host. Collected at Jervis Bay.

## HOLOSTOMUM SIMPLEX, sp.n.

(Plate vii., figs. 1-3.)

Length 3.5 mm.; the cylindrical posterior region narrower than the anterior and gradually tapering backwards; anterior region 0.68 mm. long, posterior 2.8 mm.

The clinging plug is very simple in form, being in the form of a flat lamella folded along its median, ventral, longitudinal line into two folds (Pl. vii., fig. 3), which project a little way beyond the cup. The oral and ventral suckers are large and equal in size (0.18 mm. diameter); the pharynx is much smaller.

The ovary is situated about the middle of the posterior body-region, oval or elliptical, with the long axis in a dorsi-ventral direction. The main chambers of the uterus are situated in front of the ovary; it then runs backwards as an uncoiled tube along the ventral body-wall. The vitelline glands extend into the anterior body-region and into the plug, and right back along the ventral wall to the extreme posterior end. Testes large, and divided up into a number of lobes. The male and female ducts join to form a common genital duct which traverses the genital papilla and opens on its extremity.

Found in the intestine of the Blue Crane, *Ardea novæ-hollandiæ*, Lath., at Creel Bay, Broken Bay.

## HOLOSTOMUM MUSCULOSUM, sp.n.

(Plate vii., figs. 4-9.)

Length 11 mm.; anterior region 1.2 mm., posterior 9.8 mm.

Anterior and posterior body-regions well marked off from one another. The anterior region is much shorter than the posterior region; the hinder part of the dorsal aspect of the anterior body-region presents to view two rounded elevations. The posterior body-region is circular in transverse section and gradually increases in diameter towards the posterior end, the rate of increase becoming greater in the region of the bursa copulatrix.

The clinging apparatus is especially complicated. It consists of a number of processes projecting into the cavity of the cup,

which may be divided into two groups, one group springing from the ventral wall of the cup, the other from the dorsal wall of the cup. The group of processes from the dorsal wall is in the form of the hollow plug characteristic of the genus, with a swollen dorsal ("inner wall" of Brandes) and a ventral lamellar wall. The dorsal cushion-like part is divided by a longitudinal groove into two main masses: its base of attachment to the ventral body-wall of the worm extends along for a considerable distance, but anteriorly each mass ends in a free tongue capable of being bent backwards towards the bottom of the cup. The lamellar wall of this hollow clinging plug is produced in front into a very long process which in the case of all the worms examined (a large number) extends beyond the cup cavity for a considerable distance. The edges of the extruded part are beset with a number of fine digitate processes or papillæ, which contain strong muscular fibres. These processes, and indeed the whole ventral lamellar wall of the plug, are hollowed out into a number of well defined canals, opening mostly at the ends of the processes and extending to the posterior extremity of the ventral wall of the plug, at the bottom of the cup. These canals are mostly filled with birds' red blood corpuscles, some of which are beginning to disintegrate, but precisely what becomes of these birds' corpuscles must be further looked into. The group of processes springing from the ventral wall of the cup consists of a single median lamellar lobe, arising near the anterior edge of the cup and with only a small area of attachment to the wall and a free edge directed backwards (Pl. vii., fig. 4 *pr.*): behind this lies a pair of lamellæ attached at their anterior ends but free along their lateral edges and posterior ends, which ends are also directed backwards towards the bottom of the cup: these two lamellæ are fused together for a short distance about their middle, so that together they are H-shaped. Behind this again, and also springing from the ventral wall of the cup, is another lamellous plate attached along its sides and posterior edge to the cup-wall, but with its anterior edge free and directed forwards towards the opening of the cup.

The oral sucker is of medium size (0.2 mm. diam.); the pharynx is about the same size: both are spherical in shape: the œsophagus is of some length (0.35 mm.). The ventral sucker, though well developed (0.2 mm. long, and 0.14 mm. broad), is completely covered over by the plug of the clinging apparatus, and lies embedded in its tissues and those of the ventral part of the body, communicating with the exterior only by means of a narrow thin-walled canal which opens into the cavity of the hollow plug.

A number of very strong bands of longitudinal muscle occur in the posterior body-region: near its junction with the anterior body-region they are gathered into several well marked bundles (Pl. vii., fig. 8), but towards the posterior end they have spread out and tend to become a complete circular layer of longitudinal fibres. The excretory system is very well developed, and in the front part of the posterior body-region consists of a number of well marked cavities. The vitelline glands do not occur in the anterior body-region nor in the walls of the bursa copulatrix, but in the intervening portion they are numerous and well developed. The testes are large and divided up into a number of lobes (Pl. vii., fig. 6). The genital papilla opens on the exterior by a cleft-like aperture which divides it into two parts (fig. 7).

Found in the duodenum of the Crested Tern, *Sterna bergii*, Licht., at Broken Bay.

Many of the figures were drawn by my wife.

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*Reference letters.*

*b.c.*, bursa copulatrix.—*c.c.*, cavity of cup.—*cav.p.*, cavity of plug.—*c.p.*, clinging plug.—*d.w.*, dorsal wall of plug.—*eg.*, eggs.—*ex.*, excretory vessel.—*f.d.*, female duct.—*gl.*, glands.—*g.p.*, genital papilla.—*int.*, intestine.—*l.m.*, longitudinal muscle.—*l.t.*, lobes of testes.—*m.d.*, mouths of ducts.—*œs.*, œsophagus.—*o.s.*, oral sucker.—*ov.*, ovary.—*ovid.*, oviduct.—*ph.*, pharynx; *pr*<sub>1</sub>. and *pr*<sub>2</sub>., processes arising from the ventral wall of the cup.—*rf.p.*, reflexed process of plug.—*s.m.*, sphincter muscle.—*t*<sub>1</sub>. and *t*<sub>2</sub>., testes.—*u.f.*, united posterior parts of the lateral folds.—*ut.*, uterus.—*v.d.*, vas deferens.—*v.g.*, vitelline glands.—*vit.d.*, vitelline duct.—*v.s.*, ventral sucker.—*v.sem.*, vesicula seminalis.—*v.w.*, ventral wall of plug.



## EXPLANATION OF PLATES.

## Plate v.

*Hemistomum triangulare* (figs. 1-6).

- Fig. 1.—Whole view of mounted animal ( $\times 50$ ).  
 Fig. 2.—Longitudinal section, about the middle line in most of its length, but posteriorly to one side of the middle line through a slight lateral flexure in the body ( $\times 70$ ).  
 Fig. 3.—Section through posterior end showing bursa and genital papilla, &c. ( $\times 70$ ).  
 Fig. 4.—Longitudinal section showing group of unicellular glands surrounding ventral sucker ( $\times 420$ ).  
 Fig. 5.—Transverse section through anterior body-region showing flexed lateral edges of body.  
 Fig. 6.—Sketch of an unmounted specimen; side view ( $\times 20$ ).

*Hemistomum intermedium* (figs. 7-10).

- Fig. 7.—Longitudinal section a little to one side of the middle line, showing stalked ventral sucker and characters of clinging plug and uterine wall ( $\times 37$ ).  
 Fig. 8.—View of whole animal, mounted ( $\times 20$ ).  
 Fig. 9.—Longitudinal section through the posterior end ( $\times 37$ ).  
 Fig. 10.—Slanting section through the two anterior groups of glands ( $\times 37$ ).

## Plate vi.

*Holostomum Hillii* (figs. 1-8).

- Fig. 1.—Drawing of whole animal, mounted ( $\times 20$ ). The amount of dorsal flexure shown is about the usual amount shown in this species.  
 Fig. 2.—Longitudinal section through the anterior body-region, showing the separate dorsal and ventral walls of the clinging plug ( $\times 50$ ).  
 Fig. 3.—Transverse section through the anterior body-region, showing the commencing separation of the ventral wall of plug ( $\times 50$ ).  
 Fig. 4.—Transverse section further forward than fig. 3, showing the separation of the ventral wall still further advanced ( $\times 50$ ).  
 Fig. 5.—Transverse section still further forward, and showing the ventral wall of plug completely separated from the wall of the cup; this section passes through the fused part of the two lateral portions of this ventral wall ( $\times 50$ ).  
 Fig. 6.—Transverse section through posterior body-region ( $\times 50$ ).  
 Fig. 7.—Longitudinal section through posterior body-region and bursa copulatrix ( $\times 35$ ).  
 Fig. 8.—Transverse section through bursa and genital papilla in front of the junction of the two genital ducts ( $\times 37$ ).



## Plate vii.

*Holostomum simplex* (figs. 1-3).

- Fig. 1.—Longitudinal section; not passing through the mouth of the cup ( $\times 50$ ).  
Fig. 2.—Drawing of the whole worm, mounted ( $\times 28$ ).  
Fig. 3.—Transverse section through anterior body-region showing the simple folded clinging apparatus ( $\times 50$ ).

*Holostomum musculosum* (figs. 4-9).

- Fig. 4.—Transverse section through anterior end of cup ( $\times 37$ ).  
Fig. 5.—Transverse section through cup, further back than fig. 4 ( $\times 37$ ).  
Fig. 6.—Transverse section through posterior body-region showing bands of longitudinal muscle ( $\times 20$ ).  
Fig. 7.—Transverse section through bursa and split genital papilla ( $\times 20$ ).  
Fig. 8.—Transverse section through posterior body-region, much farther forward than that of fig. 6, showing excretory vessels and muscular bands ( $\times 20$ ).  
Fig. 9.—Sketch of an unmounted specimen of *Holostomum musculosum*: 1, opening of cup; 2, projecting part of clinging plug; 3, digitate processes of clinging plug ( $\times 12$ ).